The di-muon measurements with CBM at SIS100.*

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The CBM muon detection system is designed to measure muon pairs from the decay of vector mesons ($\rho, \omega, \phi, J/\psi$) produced in heavy-ion collisions. At FAIR energies the muon momenta can be rather low, therefore, we developed a muon detection concept whith a variable definition of absorber thickness according to the muon momentum. The full design of the muon detector system consists of 6 hadron absorber layers (carbon block of thickness 60 cm with lead shielding around the beam pipe and iron plates of thickness 20, 20, 30, 35, 100 cm). The 18 gaseous tracking chambers are located in triplets behind each hadron absorber. The start version of the muon system consists of 4 hadron absorbers and 4 tracking stations. It will be used for measurements of low mass vector mesons at SIS100 energies. In the following we present results of simulations for central Au+Au collisions at a beam energy of 8 A GeV . It turned out that additional information from the time-of-flight system helps to further suppress protons and kaons. This is illustrated in figure 1. which depicts the mass squared of the particles seen by the muon detector as reconstructed from their time-of-flight as function of momentum measured in the Silicon Tracking System. Muons from ω meson decays and background particles are shown in the left and in the right panel, respectively.

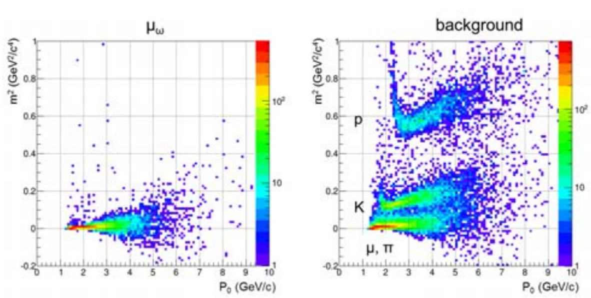

Figure 1: Mass squared of particles in the muon detector as reconstructed by their time-of-flight as function of momentum measured in the Silicon Tracking System. Left panel: muons from ω decays. Right panel: background particles.

The final invariant mass distributions of the remaining background and of low-mass vector mesons is shown in the left panel of figure 2, whereas the resulting signal-to-background ratio is shown in the right panel. The reconstruction efficiencies for mesons are 0.75% for ρ, 0.78% for ω, and 1.1% for ϕ.

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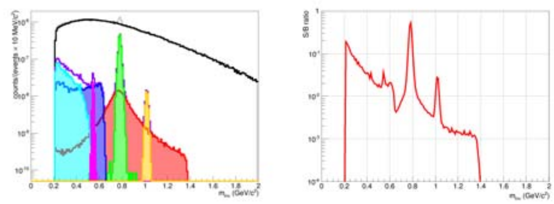

Figure 2: Left picture: Invariant mass spectrum of low mass vector mesons for 8 AGeV central Au+Au collisions. Black line - combinatorial background, red - ρ, green - ω, yellow - ϕ, magenta - η, blue - ω Dalitz, light blue - η Dalitz. Right picture: Signal-to-background ratio.

The measurement of J/ψ mesons at 10 A GeV will be an exciting experiment at SIS100 because it will provide information on the process of charm production at energies close to the threshold, in this case even below threshold. According to the HSD transport code [1], in central $Au + Au$ collisions at 10 A GeV the dilepton yield per event is 1.04×10^{-8} for J/ψ mesons. We performed J/ψ simulations in central $Au + Au$ collisions at 10 AGeV using full muon system. The invariant mass distribution of background and signal is shown in Figure 3. The signal-to-background ratio is 0.13, and the J/ψ reconstruction efficiency is 0.2%.

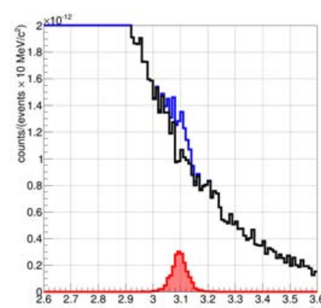

Figure 3: Reconstructed invariant mass distribution of muon pairs for central Au+Au collisions at 10 A GeV. Red histogram: J/ψ meson, black histigram: combinatorial background, blue histogram: background + J/ψ meson.

References

[1] O. Linnyk et al., Nucl. Phys. A 786 (2007) 18

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